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# Long-Term Dynamics of Iceland Plume Outflow Revealed by Basalt Geochemistry

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International Ocean Discovery Program (IODP) Expedition 395 drilled into oceanic crust at five sites parallel to plate spreading approximately 600 km south of Iceland. The recovered basalt provides a 34 Myr record of the interaction between the Icelandic mantle plume and the surrounding mantle. We measured Nd isotopes, major and trace element compositions of these basalts to investigate temporal changes in the nature and extent of this interaction. The oldest site (34 Ma), situated on crust characterized by fracture zones, has an isotopic and trace element composition consistent with normal mid-ocean ridge basalt ($\varepsilon Nd = 9.5 \pm 0.7$), and rare-earth element (REE) compositions can be modeled by passive upwelling of ambient ($Tp = 1320^{\circ}C$) mantle of standard depleted MORB mantle composition. In contrast, the four youngest sites situated at two v-shaped ridge and trough pairs (where fracture zones are absent), show a linear isotopic evolution from $\varepsilon Nd = 7.4$ to 10.1 over 15 Ma, whilst REE modelling requires a Tp of at least $1360^{\circ}C$, relatively high melt fractions, and a mixture of depleted and plume-derived mantle source components. Together, these results suggest the influence of the Iceland plume on crust formation collapsed at the sampled latitude at 36 Ma, before returning at 21 Ma and continuously evolving to present day. These dramatic changes in the extent of plume-ridge interaction fundamentally influenced mantle composition, crust dynamics, and likely the strength of deep-water ocean currents in the North Atlantic region.